THE NEW GUINEA SINGING DOG: ITS STATUS AND SCIENTIFIC IMPORTANCE

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Time is running out for the opportunity to study the New Guinea singing dog (*Canis hallstromi* Troughton 1957) to determine if they are a unique taxon. These wild canids are being threatened with hybridization from increasing numbers of imported domestic dogs (*Canis familiaris*). The controversies over their taxonomy and its status in New Guinea exist because they live in areas infrequently visited even by local residents. Thus, evidence concerning its origins, behaviour, anatomy, and phylogenetics is inadequate. The morphological, physiological, and DNA data we currently have available are from the few remaining captive representatives held in zoos and private facilities. The singing dog may be an important evolutionary link to humankind’s most ancient domesticated mammal, *C. familiaris*, and to the Australian dingo (*Canis dingo*). We refute the allegation that the singing dog originated as a feral modern *C. familiaris*, or as hybrids of *C. dingo* with *C. familiaris*, by recounting their known history within the cultural context of New Guinea. We point out some of their distinctive characteristics, including their unique estrus cycles, and outline their potential scientific merit. We conclude by offering an alternative taxonomic hypothesis.

Key words: *Canis familiaris*, *Canis hallstromi*, dingo, dog, New Guinea singing dog

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The Australian dingo (*Canis dingo*) is well known, and its genetic extinction due to hybridization with imported domestic dogs (*Canis familiaris*) seems inevitable (Corbett 1994). There is, however, another dingo-like canid that is also found free-ranging in the Australian region, one whose characteristics suggest that it may offer the best chance to study what canids in the ancestral pre-domestication dog population may have been like. With modern *C. familiaris* now being imported even into some remote villages of the New Guinea Highlands, this canid, popularly known as the New Guinea dingo or singing dog, is becoming increasingly threatened by the potential for hybridization. In addition to *C. hallstromi* and *C. familiaris*, singing dogs have been called *C. familiaris hallstromi* (Manwell and Baker 1983), *C. lupus f. familiaris* (Voth 1988), and *C. lupus dingo* (Brisbin *et al.* 1994). Only a few of the local New Guinea language names for the wild dogs have been recorded: German zoos call them urwald dingeos or jungle dingoos.

The captive singing dog population has recently been the subject of a number of studies. These studies include genetics (Savolainen *et al.* 2004), behavior (Koler-Matznick *et al.* 2004), and physiology (Simonsen 1976; Koler-Matznick *et al.* 2003; C Asa and J Bauman pers. comm. 2005). Based on these interdisciplinary studies, the captive population apparently represents a relatively pure genetic line of ancient primitive dog, closely related to *C. dingo*, but adapted behaviorally and morphologically to the New Guinea mountain habitat. According to ethnographic accounts these dogs were commonly tamed by hunters, but they do not really fit the usual concepts of domestication (Meggitt 1958, 1965; R Bulmer 1968; Clutton-Brock 1992; S Bulmer 2001; Majnep and R Bulmer 2005).

The number of possibly unique attributes documented in the captive singing dog population, as compared to *C. familiaris* and wild canid species, suggests that they have either undergone significant evolution since their arrival on the island, or they were well differentiated from other canids when they arrived there. Today, the singing dog appears to be a product of at least several thousand years of natural selection. It is, at minimum, an evolutionarily significant unit, and, at
maximum, could be its own distinct species (Simonsen 1976; Gollan 1982; S Bulmer 2001; Bininda-Emonds 2002; Koler-Matznick et al. 2002; Clark et al. 2004; Savolainen et al. 2004). Therefore, for conservation purposes, the wild singing dog should be considered a unique taxon until the contrary is clearly demonstrated.

NEW GUINEA SINGING DOG BACKGROUND

Whether the singing dog is just another population of *C. familiaris* is a serious question deserving careful consideration. Because *C. familiaris* varies greatly in morphology due to artificial selection, unlike most species, the description of *C. familiaris* is not based on diagnostic morphological characters, except for the consistently curved tail that Linnaeus (1758) used as his main defining trait compared to gray wolves (*Canis lupus*). Rather, the usual working definition of *C. familiaris* is functional and niche-based, meaning roughly dogs that live near or with humans symbiotically as commensals or as exploitive parasites. This concept is relevant only to the last few thousand years of dog history and singing dogs have not been part of such anthropocentric relationships. They have a pre-domestication relationship with humans (discussion below), but there is no evidence that, except in the one reported case of captive breeding with artificial selection, it involved attempts at domestication (R Bulmer 1968; Majnep and R Bulmer 1977; S Bulmer 2001; Majnep and R Bulmer 2005).

The most important reason to question assertions that singing dogs are merely *C. dingo/C. familiaris* hybrids (Corbett 2004) or feral *C. familiaris* (Schultz 1969) is that there is no direct evidence to support these claims. For instance, no identified *C. dingo* remains have ever been found in New Guinea. Although their opinions of the singing dog’s phylogenetic relationship to other canids varied, even from the earliest accounts, observers of the wild mountain singing dogs commented that these dogs appeared to be a separate type from the New Guinea village dog *C. familiaris* (DeVis 1911; Longman 1928; Wood-Jones 1929; Tate 1944). Wood Jones (1929) was the first to suggest that the singing dog could be the ancestor of *C. dingo*. He further concluded that the Mount Scratchley specimen, the first specimen available for examination, differed significantly from the *C. familiaris* of other Pacific islands. DeVis (1911) collected the Mount Scratchley specimen at about 2,400m in 1897 and described it. Every subsequent researcher, with the exception of Schultz (1969), whether they considered behaviour, DNA, morphology, or physiology, has come to the same conclusion: in the trait each investigated, the singing dog differed to some degree from the generally accepted standards for modern *C. familiaris* (i.e., Simonsen 1977; Ortolani 1990; Koler-Matznick et al. 2003, 2004; Savolainen et al. 2004).

Schultz (1969) studied captive singing dogs and concluded they were domesticated because they were morphologically more variable than a population of a wild species would have been (mainly in leg length), they had white markings, and they were friendly with their keepers. However, Schultz (1969) was mistaken in his assumption of morphological uniformity in wild canids. There is considerable morphological variation in many populations of wild canids. For instance, within one pack of wolves there may be significant non-age and non-sex-related size variation, and coat color can vary from cream to gray to black (Mech 1970). The white markings on the underside of the singing dog’s chin and the white tail tip may have adaptive value, serving important intraspecific signaling functions (Koler-Matznick et al. 2004). White markings on the ventral body, toes, and tail tip, are fairly common occurrences in many solid-colored mammal species. These white areas are due to the failure of embryonic melanocyte migration to reach those areas. This trait has undoubtedly been exaggerated in the inbred captive singing dog population, but in any case, variable markings should not be used as evidence for or against the singing dog being formerly domesticated. As for captive singing dogs socialized to humans and acting “friendly” to familiar people, one has only to look at other captive-born and socialized mammals of many species to see this is a common behavior and should not be used as evidence they are feral domesticants, contrary to Schultz (1969).

Flannery (1995) and others contend that the singing dog is a feral domesticant, apparently because it was introduced to the island by human transport. However, New Guinea was populated by humans by about 45,000 years ago (O’Connell and Allen 2003), and wild animals were being transported between Pacific islands by at least 20,000 years ago (Flannery and White 1991). Thus, the founders could have arrived before dogs are believed to have been fully domesticated (i.e., 12,000 yrs BP [Davis and Valla 1978] to 15,000 yrs BP [Savolainen 2004]). Wild dogs had only to be tamed to be transported. “Tamed” is used here instead of “domesticated” because the usual definition of the latter term includes the conditions that the population’s freedom of movement and reproduction are under human influence, with ongoing artificial selection for traits useful to humans (Zeuner 1963; Clutton-Brock 1992). These conditions are not met with the singing dog and neither is there any evidence that they were met with their ancestor. Recently, Iyengar et al. (2005) suggested that certain populations of Southeast Asian dogle (*Cuon alpinus*) probably descended from specimens transported by man from India (or vice versa). Another example of a prehistorically translocated canid is the Channel Island fox (*Urocyon littoralis*). Now listed by the IUCN as an endangered species, *U. littoralis* was similarly
transported by humans and artificially dispersed within the California Channel Islands several thousand years ago (Collins 1991). Yet these canid populations with transported ancestors have never been labeled feral domestics as has the singing dog. In another survey, 18 mammal species were considered introduced to Southeast Asian Islands, including the Philippines and Indonesia, by the Late Pleistocene. These were all wild species, including several forms of deer and primates (Meijaard 2003).

**Origin of the captive population**

As Corbett (2004) rightly points out, the current captive singing dog population is descended from eight specimens reportedly kept by Highland people, and not directly caught in the wild by the explorers who brought them out (Schultz 1978; Koler-Matznick et al. 2003). This does not mean, however, that these specimens were village *C. familiaris*. The remoteness of the primary source villages of the first captive specimens, the former and continuing geographic isolation of the singing dogs from other canids in the high elevation New Guinea mountains, and the Highlander’s particular knowledge of and regard for these distinctive canids must be considered when contemplating the origin of the captive population.

According to Titcomb (1969), Troughton, who described them in 1957 as *Canis hallstromi*, asserted that the first pair of singing dogs brought out in 1956 was secured by Papua New Guinea District Officer J.P. Sinclair and Medical Assistant Albert Speer while they were on government patrol in the previously unvisited Levani Valley, which was in the then uncontrolled Huri-Duna country of the Southern Highland Province. Sinclair and Speer sent this pair as a gift to Sir Edward Hallstrom’s Fauna Station at Nondugal in the Western Highlands. Hallstrom subsequently donated them to the Taronga Zoo. Figure 1 is a previously unpublished photograph of this pair. Titcomb (1960: 65) also relates that “In October 1960, Sir Edward Hallstrom kindly wrote to the author about *Canis hallstromi*, found and reared at Nondugal, New Guinea . . . ,” a confirmation of this origin for the first captive pair. In contrast, Titcomb (1969: 65) also quotes Clyde A. Hill, Associate Curator at the San Diego Zoo (which received singing dogs from the Taronga Zoo about 1958), as saying on 2 March 1965 that, “The original pair was captured and raised by native tribesmen in the remote Shangra-La [sic] Valley, an area first entered by white men in 1956.” Perhaps Hill was merely mistaken in his recollection of the name of the valley, as no “Shangri-La” of any spelling is found referenced in any publication concerning the area.

Although these three accounts of the original pair differ in details, it should be noted that none of them described the specimens as “village dogs.” A previous attempt by Hallstrom to bring out a pair of singing dogs 1954 had failed when the specimens escaped confinement, killed “highly prized poultry,” and were “consigned to the local natives for food” (Titcomb 1969: 64). Five additional captive population founding specimens were obtained by the 1976 German-sponsored expedition to the remote Eipomek Valley, Irian Jaya, West Papua (Schultz 1978; Voth 1988). These specimens had reportedly been bred by the locals, apparently one of the few traditional people who actually allowed their captive singing dogs to breed. However, the villagers indicated that their original dogs came from the wild (Voth 1988). The eighth captive founder was a female, reported to be “wild caught” and kept at the Baiyer River Sanctuary, Papua New Guinea, (L. Lim pers. comm. to I. L. Brisbin, Jr. 1988).

**Ethnography**

The people of New Guinea are known for their detailed knowledge of the animals in their environment. Visiting biologists have reported that the locals recognized and had named essentially all of the species the biologists recognized (Mayr 1963; R Bulmer et al. 1975; Majnep and R Bulmer 2005). In all local informant reports to date, the New Guinea Highland wild dog has a different local name than the village *C. familiaris* (R Singadan pers. comm 2001; M Wilangue pers. comm. 2003; W Waringi pers. comm. 2005). Some local myths include origin stories that indicate that the wild dogs brought fire or language, or even that they are spirits of deceased ancestors and so must not be disturbed, perhaps indications of the antiquity of the wild dog/human relationship in New Guinea (Titcomb 1969; R Singdan pers. comm. 2002). In general, canids did not fit within the Highlander’s traditional way of home life. Most Highlanders usually did not, and still do not, keep *C. familiaris* as companion animals, although small numbers were occasionally kept for their teeth (taken for use as valuable ornaments after death of the animal). The original practice of many of the Highland peoples was to capture wild singing dog puppies (most often only males) and raise them as hunting aids (R Bulmer 1968, 1976; S Bulmer 2001; Majnep and R Bulmer 2005). Even today, many elders can remember the use of tamed singing dogs as hunting aids. These hunting dogs were kept at the men’s communal houses and were personally cared for by the male hunter-partner. One of the singing dog’s forelegs was often tied up to the neck to prevent roaming (Schultz 1978; Majnep and R Bulmer 2005). Some Highlanders have in recent times started keeping *C. familiaris*, both native village *C. familiaris* from the Lowlands, where dogs are integrated into human society as companion animals and hunting aids, and imported non-native dogs. However, the local Highland informants are quite aware of which dogs were obtained from the wild, if the ancestors of their present dogs had been crossed with the captive wild dogs, and how many generations ago that occurred (Wilangue 2002).
The archaeological record

New Guinea has been relatively little explored archaeologically. While there are many districts that have archaeological sites where bones of other animals are present, there are few sites with dog bones (S Bulmer 2001). This, it is argued, is because most Highland sites reflect traditional hunting and dogs were never hunted or eaten by most Highland societies. This is because many Highland societies, like a very large number of societies elsewhere in the world, believe that the dog is a dirty animal (e.g., because of their coprophagy and scavenging on decayed carcasses), and its meat therefore is not eaten. Archaeological evidence reflects this in the absence of dog bone in bone middens. However, some Highlands sites contain small numbers of dog canine teeth, which indicates they may have been used as personal ornaments by the Highlanders.

There are some lowland societies that today do eat dog meat, and keep dogs for this purpose, but archaeological evidence for this is rare. Only two sites of the many hundreds excavated so far have evidence of the eating of dog, such as the presence of a variety of cranial and postcranial dog bones and charred dog bones, which suggests cooking. The rarity of New Guinea dog bone evidence could be due to the activity of pigs. Other available evidence of the presence of dogs include bones of other animals that exhibit marks of carnivore gnawing, and, at one site, a dog burial (S Bulmer 2001).

Singing dogs were highly valued by Highland hunters because they helped to increase the products of the hunt several times over (Majnep and R Bulmer 2005). Those hunting dogs that excelled in their services to their human partner were treated as an honorary human in their final burial rites, and their bones were placed in branches of a forest tree, while the jaws of their kills decorated the human hunter’s house.

Although Savolainen et al. (2004) reported that the oldest dog find in the Pacific Islands near Australia was on Timor, dated 3,500 BP. However, there are earlier dog finds in New Guinea from Lowland Ramu sites, dated to ca. 5,500 years ago (S Bulmer 2001). These predate the oldest C. dingo remains, which are dated to 3,450±95 BP (Corbett 1995), and offer another indication that C. dingo could, as Longman (1928) suggested, be a descendant of the singing dog.

SCIENTIFIC SIGNIFICANCE OF THE SINGING DOG

Bearing in mind that nearly all investigations have so far been of captive specimens, and that most are still preliminary, several inferences can be drawn, and a few tentative conclusions made, about the potential scientific value of the singing dog. The arguments for singing dog significance include its apparent antiquity and purity as an evolutionary unit, along with its several unique genetic, behavioral, ecological, reproductive, and morphological traits. The cold, damp weather of
the wild singing dog range, and the extremely remote and steep terrain of its habitat, are probably the factors which have kept them an isolated genetic line. These environmental factors, however, also make field studies demanding and daunting. Even for those who argue that this dog is merely a long-term isolate of *C. familiaris*, it would nevertheless be of value as a research subject (Brisbin and Risch 1977) and would have conservation value as a distinct race or subspecies.

**The singing dog as a natural form of dog**

There is no definitive DNA evidence yet of a direct *C. lupus* ancestor for *C. familiaris*, only that *C. lupus* and *C. familiaris* are more closely related to each other than either is to other species of *Canis*, and this could simply be an indication they had a recent common ancestor (Vila et al. 1997; Wayne and Ostrander 1999). It is possible that the main *C. familiaris* ancestor was a heretofore unknown or unrecognized species of medium-size generalist scavenger and small-game predator, similar in ecology to a golden jackal (*Canis aureus*) or coyote (*Canis latrans*) (Dahr 1941; Manwell and Baker 1980; Koler-Matznick 2002). Unlike the large *C. lupus*, these smaller, less specialized canids easily adapt to surviving in anthropocentric environments (Gier 1975; Poche et al. 1987; Bekoff 2001). If this hypothesis is supported by further research, the singing dog and *C. dingo* would be the best living representatives of the *C. familiaris* ancestral type. In any case, recent preliminary estimates from captive singing dog mtDNA suggest that their population could have, like *C. dingo*, been a separate evolutionary line from modern *C. familiaris* for at least 4,600 to 10,800 years (Savolainen et al. 2004). The genetic integrity of *C. dingo* is now highly compromised by introgression from imported *C. familiaris* (Corbett 1995). Unless politically unrealistic and economically expensive measures are implemented soon, the word “dingo” will come to mean “just a mixed breed feral dog.” If the singing dog proves to be the only other remnant of a separate evolutionary line of dog from *C. familiaris*, then they would be invaluable for studies of speciation processes (Coyne and Orr 2004). Lastly, the singing dog could be a relic sister species to the ancestor of *C. familiaris*, one of the numerous *Canis* species that arose during the Early Pleistocene canid radiation in Asia and have been presumed to be extinct (Pei 1936; Olsen 1985; Sotnikova 2001).

The acceptance of *C. dingo* and the singing dog as unique taxa is complicated by the fact that few data are available on the evolutionary rates and speciation processes in canids. It is impossible to use reproductive isolation alone to define a species in the genus *Canis* because even species that have been documented through the paleontological record as separate evolutionary lines for more than a million years can produce fertile hybrids, and mating systems have been highly conserved so that natural hybrids are occasionally produced (Gier 1975; Lehman et al. 1991; Gottelli et al. 2004; Sillero-Zubiri et al. 2004; Verginelli et al. 2005).

*Canis dingo* and the captive singing dog population are genetically distinct enough in mtDNA haplotypes and microsatellite markers to make a determination of whether or not a specimen is pure or a *C. familiaris* hybrid (Wilton et al. 1999; Wilton 2001; Savolainen et al. 2004). Therefore, these populations are not genetically equivalent to any other tested dogs. If molecular characteristics are accepted as equivalent to genetic differences, then there are also data showing that the SINGING DOG is genetically unique compared to its nearest relatives. Simonsen (1977), in an electrophoretic molecular study, found that the singing dog had two of 18 blood enzymes that differed from the type shared by *C. dingo*, *C. familiaris*, and *C. lupus*, but co-occurred in *C. latrans* and red fox (*Vulpes vulpes*). In another study, Shaughnessy et al. (1975) examined three blood proteins in *C. dingo* and *C. familiaris* and found no differences, suggesting that *C. dingo* could be genetically closer to *C. familiaris* than is the singing dog, perhaps due to recent hybridization.

**The question of singing dog/*C. familiaris* hybridization**

Although it is argued that *C. familiaris* has been in the Lowland and coastal areas of New Guinea for at least 3,300 years as part of the Lapita cultural complex (S Bulmer 2001), and for 5,500 years as part of the Sepik-Ramu trading set (Swadling et al. 1991), there are reasonable arguments against their extensive genetic introgression into the wild singing dog population. An unknown proportion of New Guinea Lowland village *C. familiaris* are thought to have been brought to the island from a number of sources outside New Guinea, particularly to the northern coast. However, a large number of the Lowland specimens have features that superficially resemble, to some extent, singing dogs. These dogs may be at least partially descended from wild singing dogs that in the past occupied the Lowlands before that habitat was turned into agricultural land. Preliminary mtDNA results show that some of the few extant Highland village dogs sampled to date have singing dog/*C. dingo* haplotypes (P Savolainen pers. comm. 2005). However, the Highland people who owned the sampled dogs claimed they were wild dog X village dog hybrids, so this result was not unexpected (Wilangue 2002). Local Highland residents report that both in the past (R Bulmer 1976; Majnep and R Bulmer 2005) and recently (M Wilangue pers. comm. 2003), wild singing dog puppies have been captured for use as hunting partners. In some communities, the captured wild dogs are allowed to breed with the village *C. familiaris* in hopes the offspring will have increased hunting prowess while retaining the greater tractability
of the domestic dog (R Bulmer 1976; Majnep and R Bulmer 2001). Thus, gene flow has taken place from the wild singing dog to the village C. familiaris. However, until further genetic testing proves otherwise, genetic introgression from the village C. familiaris into the wild singing dog population can be assumed to be nonexistent or exceptionally rare due to pre-zygotic behavioral isolation between village C. familiaris and wild singing dogs, and to the geographic isolation of the singing dogs.

Behavioral isolating mechanisms have been effective in preventing widespread introgression of C. familiaris into other wild canid populations and have almost certainly played a role in the case of the singing dog. For example, during their several thousand years of sympatry, the indigenous, free-ranging Indian C. familiaris has not introgressed into Canis lupus pallipes in India, despite their largely synchronous breeding seasons (Aggarwal et al. 2003; Sharma et al. 2004). In contrast, the supposedly more distantly related C. lupus and C. latrans have hybridized in the Great Lakes area of North America, and some other otherwise normal C. lupus now carry a C. latrans mtDNA type (Lehman et al. 1991).

When in its natural undisturbed Highland habitat, the singing dog would not be at all likely to mate with an encountered C. familiaris. The New Guinea village C. familiaris, the only domestic dog that has had a significant chance to hybridize with the singing dog, is adapted to a tropical climate and would therefore have a difficult time surviving for any significant period in a Highland village, let alone in the c. 2500-4700 m altitudes where wild singing dogs range. Therefore, it is highly unlikely that free-ranging or feral C. familiaris are resident in singing dog habitat. Locals report that C. familiaris specimens entering wild singing dog territory are attacked by the resident wild dogs (Wilangue 2002). Captive behavior studies (Koler-Matznick et al. 2004) support this observation and suggest that wild singing dogs likely have a bonded, territorial pair, rather than a wolf-like pack social structure. Captive singing dogs are very defensive of their living space against other canids, and normally are not acceptant of unfamiliar C. familiaris or strange singing dogs in any circumstances (Koler-Matznick, et al. 2004). They also display severe same-sex aggression during the breeding season if they are in a pair bond, or if there is a potential mate present. Given the scarcity of prey in the New Guinea mountain environment and the absence of large game (Flannery 1998), it seems ecologically appropriate for singing dog pairs to defend a territory. Therefore, the few C. familiaris that accompany humans into the remote Highland regions would be highly unlikely to breed during that journey, because if they were valued or useful enough to take along, their owners surely would exert control to keep them from potentially injurious encounters with aggressive wild dogs. Flannery (1998) recounted that, when in the Star Mountains on a mammal collecting expedition, his field assistant, a Highland man, highly valued the hunting dogs he brought along on the expedition to help catch specimens. In addition, even an un-paired estrus singing dog female would be extremely assertive toward a strange male. In captivity, introductions of a female to a strange male have to be done slowly, with both controlled, because if the male approaches too rapidly before the female has had sufficient time (at least several minutes) to become familiar and relaxed near him, she will react aggressively, with snarling and snapping, occasionally even biting him (Koler-Matznick et al. 1994).

Possibly Unique Reproductive Pattern

Another at least partial barrier against domestic C. familiaris introgression into the wild singing dog population is the female singing dog’s seasonal breeding pattern. Singing dogs have unusual estrus cycles compared to nearly all canid species. Records of 25 females kept by the authors from 1988 to 2000 and a two-year fecal hormone study of the cycles of eight captive females by C. Asa and J. Bauman, showed that the singing dog uniquely combines a strong annual seasonality, with the flexibility, if not impregnated the first cycle, to have a second estrus, and sometimes a third, within a few weeks after the end of the first (Brisbin and Risch 1997; Koler-Matznick et al. 2003; C Asa and J Bauman pers. comm. 2005). The captive singing dog annual mating season, which begins in late September, has not shifted in approximately 20 generations after translocation from New Guinea to higher northern latitudes, suggesting the seasonal rhythm is endogenous.

Singing Dog ecology

The singing dog is now New Guinea’s top (non-human) mammalian predator, and has probably been so since the local extinction of the Thylacine some 2,000 - 5,000 yrs BP (Strahan 1983; Guiler 1998). The only field study of singing dog ecology to date was by Bino (1996), who briefly collected scats, observed secondary signs (beds, paw prints, etc.), and interviewed locals in the Mekil reservation area. Bino (1996) concluded that the wild singing dog is a formidable predator, even attempting to attack cassowaries (Casuarius bennet) several times their body mass, and kleptoparasitizing New Guinea Harpy eagle (Harpyopsis novaeguineae) kills. He reports that the Mian people of the Mekil area say wild singing dogs are often sighted around Pandanus spp. and Elaeocarpus spp. trees during the fruiting season, eating the fallen fruit and most likely also attempting to ambush prey that come to feed. Bino (1996) also reports that the singing dog beds he located seemed to be used
infrequently, even perhaps on a seasonal basis, and so in the Meikil area they may be transient, hunting over a larger territory.

The fact that the singing dog, like *C. dingo*, is a self-sustaining wild population, one apparently in ecological balance with its prey (*i.e.*, no local extinctions of prey species by singing dogs have been confirmed), is an indicator that they were not domesticated when first introduced to New Guinea. With one exception, the now extinct Galapagos Island Dog (Barnett and Rudd 1983), no extant feral *C. familiaris* population has ever been reported to be self-sustaining demographically, without some degree of dependency upon humans (Scott and Causey 1973; Nesbitt 1975; Daniels and Bekoff 1989; Biotani et al. 1995). Feral *C. familiaris*, even in the absence of canid or large felid competitors, evidently do not become, like the singing dogs, an ecologically integrated predator. Field studies will be vital to further elucidate the singing dog’s role in the New Guinea Highland’s ecology, including their possible deleterious effects on rare prey species.

Corbett (2004) stated that “... there are … few ecological data mainly because no wild singing dogs have been captured or validated seen for several decades.” If we assume by “validly seen” Corbett means by non-native scientifically trained observers (there are numerous reports from locals), this is a misstatement. In Flannery (1995) there is a photo of a wild singing dog taken by the author at the remote New Guinea Star Mountain location of Dokfuma – translated as the Place of the Dog – in 1989. Flannery (1998: 174) states in reference to the howling of the singing dogs that, “For me, if [what he terms “the haunting call”] is always evocative of the highlands.” So, while uncommon, the dogs were present during Flannery’s Highlands research. Recent reports from some local Highlands people indicate the singing dog is now absent from many parts of its former range, but it is still being reported from the more remote, high altitude areas (R Singadan pers. comm 2001; M Wilangue pers. comm. 2003; W Waringi pers. comm. 2005). We therefore submit there are ever few ecological data available only because little effort has been made by non-local scientists to observe the wild singing dogs.

CONCLUSION

It is obvious from behavioral, morphological, and genetic characters that the singing dog is a dog, not a wolf or jackal. The question that remains to be answered is “What dog?” We are convinced the answer is that the singing dog, and pure *C. dingo*, are incipient sibling taxa, and their order of derivation will likely be resolved by further research. Whenever and wherever the singing dog originated, today there can be no doubt that it is at minimum an evolutionarily significant unit (Moritz 1994; Bininda-Emonds 2002) and deserves the same thorough and objective study that would be applied to distinctive populations of other taxonomic groups. The final determination of the species status of *C. dingo* and the singing dog will be reached through an interdisciplinary examination of genetic, morphological, demographic, physiological, and behavioral evidence. Until such definitive information is available, it is premature to arbitrarily dismiss the singing dog as nothing more than a feral *C. familiaris* or a *C. dingo/C. familiaris* hybrid. The information presented in this paper, and in Koler-Matznick, et al. (2003), is intended to encourage targeted investigation of the singing dog as a significant evolutionary unit within the genus *Canis*.

The people of Papua New Guinea recognize the singing dog as a unique endemic that is also an important part of their living cultural heritage. A not-for-profit group to promote wild singing dog study and conservation, the New Guinea Singing Dog Conservation Society, Papua New Guinea Division, has recently been formed (M Wilangue and K Mondiai pers. comm. 2006). Having an in-country source of support and information will facilitate field research and, ultimately, singing dog conservation.

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